GRAPHIC SCIENCE

A SPECIAL ISSUE ON EDUCATION

MAY, 1961

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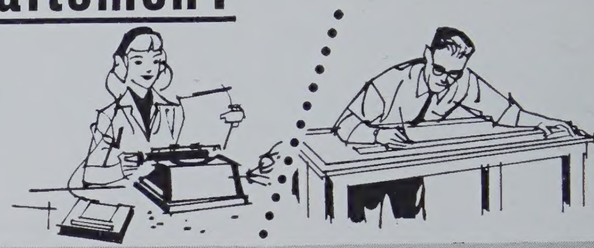

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GRAPHIC SCIENCE

THIS ISSUE 12,000 COPIES

MAY 1961

VOLUME 3 NUMBER 5

The Magazine Serving Engineering Drawing Management—covering drafting, reproduction and microfilming, technical illustration, drawing standards and engineering documentation.

ARTICLES

DEPARTMENTS

Next Month

AMERICAN AND BRITISH PROJECTION, by the late Guy L. Murray

An unfortunate ambiguity can occur as the result of first angle projection which leads to parts being manufactured laterally reversed or even turned upside down

MAP DRAFTING AND REPRODUCTION, by Arthur L. DuBois

A description of the mapmaking techniques of Rand McNally with a history of the development of the mapmaker's art.

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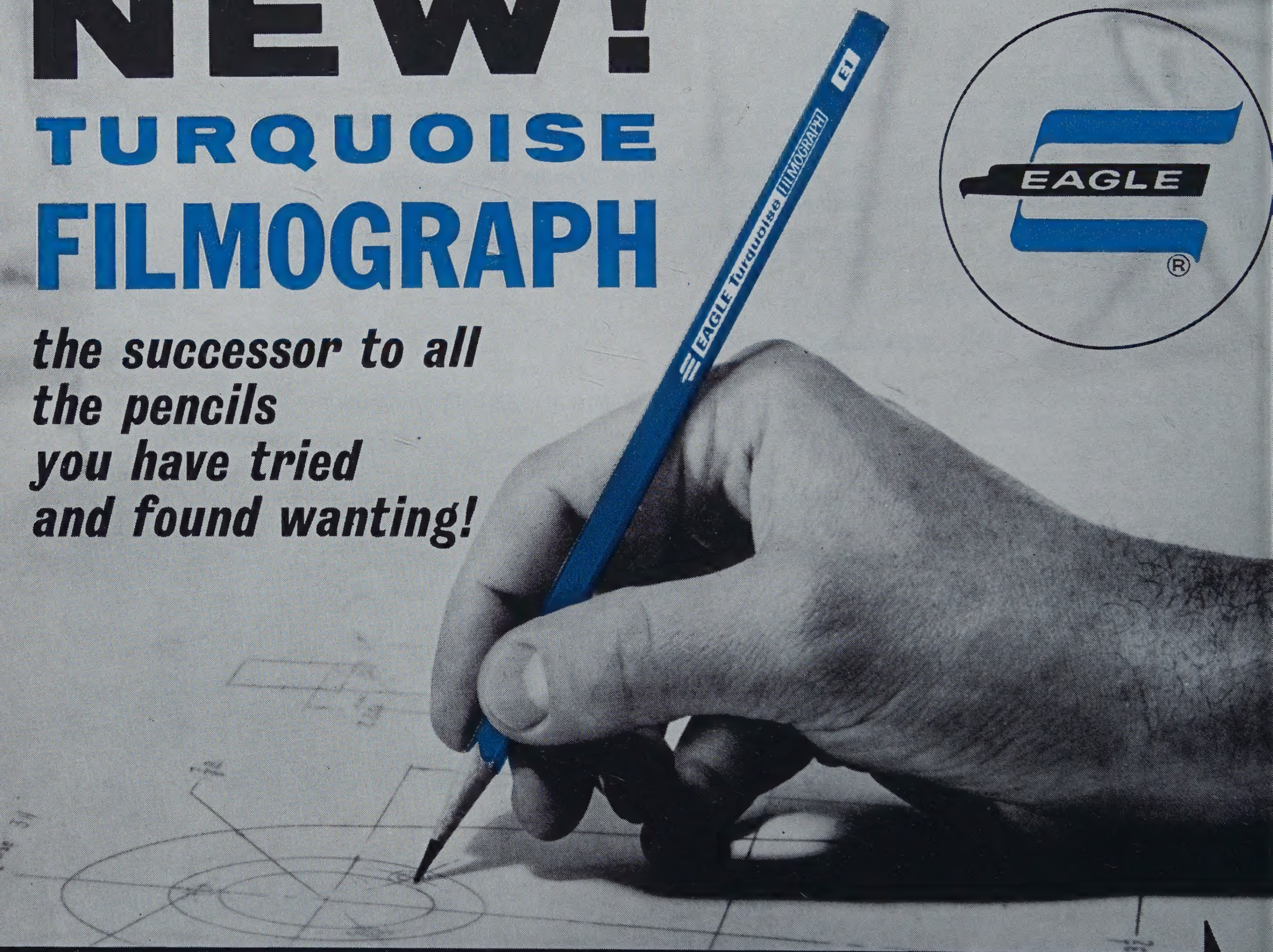

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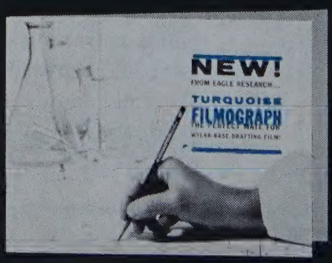

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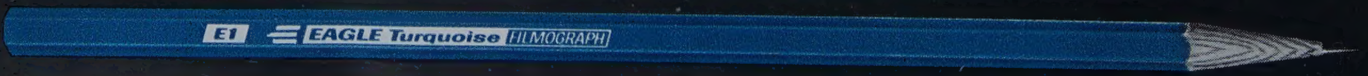

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Letters

Help on Microfilming

Sirs:

We want you to know how much we appreciate the publication of Mr. William Blocher's article in your latest issue. We feel that the commercial reproduction firm has much to offer the government and industry in microfilming of engineering drawings. The article by Mr. Blocher will be a great help in our program to educate the user of microfilm.

Thank you for your cooperation.

RAY GOOD, JR.
Executive Secretary
International Association of Blue Print and Allied Industries
33 East Congress Parkway
Chicago 5, Illinois

More on Polyester Films

Sirs:

The lead article in your March issue on Polyester Films by Ernest D. Acevedo is a truly topnotch summation in a brief few pages of almost all of the important aspects of an increasingly vital subject.

In view of the thorough approach, we believe a serious oversight in both the summary chart and the commentary should be called to the attention of your readers. We refer to the omission of any reference to the availability of contact washoff reproductions on polyester film bases. Post 229PE ReproTrace Films have received steadily increased usage since their introduction in 1959, not only due to the excellent quality of reproduction characteristics, but also due to 1) the special 12-month shelf-life feature of the coatings, 2) the moistened eraser feature of eradication of images, and 3) the compatability of matte surface that provides uniformly similar drafting characteristics with Post 126 Polytex Tracing Film.

Though there are many topnotch reproduction films currently on the market today, including Post diazotype Vapo TufTex 208PE, serious investigators of polyester films for certain reproductions should review also the advantages of washoff 229PE.

CLAY SEIPP
Frederick Post Company
Director of Marketing
Box 803
Chicago 90, Illinois

Some Help for Mr. Smith

Sirs:

In reference to the letter from Mr. William Smith, Jr., which appeared in your March issue on the subject of job classification for draftsmen, layout draftsmen, and designers, may I suggest a handbook issued by the Standards Division, U. S. Civil Service Commission, entitled "Handbook of Occupational Groups and Series of Classes." Of particular interest would be Engineering Technician Series, GS-802, and Engineering Drafting Series, GS-818.

This handbook is obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., and is dated July, 1958. The price is $3.00.

The two series mentioned above cover in detail the various grades established in the Federal service, experience required, education, description of various work levels, etc.

NICHOLAS M. RASKHODOFF
5728 Euclid Street
Cheverly, Maryland

Military Questions

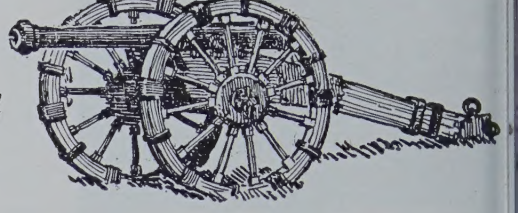
Sirs:

Mil-D-70327, the new Military Specification for engineering drawings, made mandatory on March 16, 1959, has caused some confusion throughout the country. Especially in the electronics and electromechanical field. In many cases a clear picture of the requirements and types of drawings to be delivered to the military are not completely understood. The request for bid usually calls for drawings to be per Mil-D-70327. This specification covers such a large span that no set or direct requirements are spelled out. In my opinion there are still questions that are vague, such as: What are the drawing requirements on purchased parts, on Mil approved parts, on printed wiring packages, etc.? Maybe there are others who are interested in getting some of these items cleared up. I hope so.

PAUL P. GEIER
Drafting Supervisor
Development Engineering
Mechanical Division
2003 East Hennepin Avenue
Minneapolis 13, Minnesota

Military Engineering Documentation

by W. S. Hutchinson



Microfilm's Place in DoD Engineering Data Systems Part II

SELECTION of the type and quantity of data necessary for intended uses by functional application is made with the aid of the Data Check List (see Fig. 1).

The data generally needed for the principal intended uses within the Navy is shown in Fig. 2.

Different data must be rated in importance according to its value as a source of information to the user. This is in order that the data will be brought to his attention in the order of its significance. The entire range of data should be capable of presentation in a descending sequence of specificity to a problem, as in design, maintenance, etc.

The actual rating of different data should be accomplished by each user within his functional area, as he knows with greatest accuracy what type and kinds of data he needs for decision making. This data rating is not the same as data provisioning. Data provisioning is concerned with the summation of data required to support a given operating function in the total sense. To give an example: for the maintenance support of a missile, certain drawings, lists, specifications, standards, etc., must be procured and stored for expected contingencies. No rating value is assigned in that process to the relative importance to any specific data. All of it is considered as equally essential if provisioned at all. This is a go or no-go proposition.

In securing better control over data utilization, however, it becomes important to go the further step; i.e., assessing the potentiality of data value with regard to certain sets of predicted conditions. On this basis,

Review of this material does not imply Department of Defense indorsement of factual accuracy or opinion.

DEPARTMENT OF THE NAVY
DATA CHECK LIST FOR

NAVY PROCURED ENGINEERING DRAWINGS, ASSOCIATED LISTS AND ADDITIONAL DATA

Identifying Number________

Contract Date:
Item: ________
Prospective Sources of Supply: ________
Estimated Total Price: ________
Estimated Data Cost: ________
Has this item (or a substantially identical one) been previously procured? ________

		INTENDED USES OF DATA																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 a	18 b	18 c	18 d
	Needed by	Approval & Evaluation	Quality assurance 9 Inspection)	Installation	Operation	Maintenance	Emergency Manufacture	Repair & Overhaul	Development of Performance Specifications	Development of Component Parts Specifications	Design & Interchangeability Control	Provisioning	Routine Reprocurement or Manufacture by Government	Reprocurement or Manufacture for Mobilization	Remarks	Class of Drawings	Non-Proprietary Data Only	Proprietary Data	Limited Rights	Unlimited Rights
Check horizontally the intended uses in Columns 3 to15																				
TYPE OF DATA																				
Arrangement Dwgs																				
Assembly Dwgs																				
Construction Dwgs																				
Detail Dwgs																				
Detail Assy Dwgs																				
Diagram Dwgs																				
Drawings of Standards																				
Elevation Dwgs.																				
Envelope Dwgs																				
Erection Dwgs																				
Inseparable Assy Dwgs																				
Installation Dwgs																				
Instl Control Dwgs																				
Matched Parts Dwgs																				
Mono-Detail Dwgs																				
Multi-Detail Dwgs																				
Plan Dwgs																				
Source Control Dwgs																				
Schematic Dwgs																				
Spec Control Dwgs																				
Tabulated Dwgs																				
Undimensioned Dwgs																				
Shop Accessory Dwgs																				
Process Sheets																				
Instruction Manuals																				
Company Standards																				
Special Design Data (List)																				

Prepared by: Date:
Approved: Date:

Figure 1

DATA GENERALLY NEEDED FOR PRINCIPAL INTENDED USES

Navy Intended Use—Approval and Evaluation
Design data and information adequate to permit evaluation of performance and to verify conformance to naval requirements. Data for this purpose is normally delivered prior to proceeding with detail engineering and in any event prior to release for production.

Quality Assurance (including Inspection)
Final data describing quality characteristics to assure continued production and maintenance of required quality and reliability. Includes acceptance and rejection criteria, acceptable tolerances, reference to standards, test and inspection procedures, process controls, quality and reliability levels, inspection lists, and classification of defects.

Installation, Operation, Maintenance, or Repair and Overhaul
Engineering data and information adequate to enable installation, maintenance, or repair and overhaul without assistance from the original contractor or supplier.

Emergency Manufacture for Repair and Overhaul
Engineering data and information adequate to enable emergency manufacture by the Navy. Emergency manufacture is not a common practice in the Navy and is resorted to only when items and parts are not immediately available from either commercial or naval sources of supply to effect timely overhaul or repair work.

Development of Performance Specifications
Proposed performance specifications or design data and information adequate for engineers to develop performance specifications, sufficient to permit interchangeable equipment or suitable substitutes to be procured competitively. (This use does not extend to developing interchangeable components and parts.)

Development of Component Parts Specifications
Design data and information adequate for engineers to develop design specifications sufficient to permit component parts and materials obtainable from a number of known sources to be procured competitively. In general, such parts are of a standard design configuration or have commercial equivalents.

Design and Interchangeability Control
Data necessary to control and maintain design integrity with interchangeability of parts, components, and end items. Data is required in sufficient completeness to maintain engineering and design changes or revisions, cost control, material standardization, performance, reliability and safety.

Provisioning
Provisioning data which is to be used primarily for the identification of items of supply, determination of initial requirements to support and maintain items for an initial period of service, the establishment of data for catalog, technical manual, and the preparation of data to assure delivery of necessary support items with related end items.

Procurement or Manufacture of Items and Parts for Stock, Repair, or Replacement (whether Routine or for Mobilization Purposes)
Description or illustration of items, materials, or parts, fully adequate to enable subsequent procurement from a competent supplier or manufacture by a Government facility so as to assure the requisite safe, dependable, and effective operation of the equipment. Necessary data is to be provided for proper identification as to performance ratings, primary dimensional features, electrical power and voltage ratings, resistance values, mechanical and electrical connections, physical characteristics, primary identity of chemical composition, tests and evaluation, or other necessary design features not included above, to fully identify the items. Only that essential data as set forth in Specification MIL-D-70327 is required for components, items, and materials, which are commercially available or which are described in Government or industry specifications or standards.

Figure 2

then, the data can be assigned as of primary, secondary, or subsidiary value, according to its importance as a source of information to the respective user in solving problems or meeting operating requirements.

The primary purpose of data rating is to separate out the vital data from the welter of data available. This data reduction, then, simplifies search for salient facts, thus conserving the user's time.

What do we look for in the ultimate engineering data system? First, there must be flexibility. The system should satisfy both the smallest and the largest user—also the most meticulous user. Second, timing is important. Data inputs must be synchronized with demand rates to provide outputs according to realistic schedules.

And third, economics plays an important part in deciding what process is best suited to a particular set of conditions. Here we become involved with data forms, frequency of use, amount handled, the re-usability factor, extent of processing involved, speed of retrieval, etc.

The time needed to solve the complex problems met in design, production, logistics, operations, and maintenance has greatly increased, making impractical manual methods of data processing. We must speed up with automation where practicable to keep an adequate state of military readiness. Compressing the time factor can be achieved by selectively applying machine techniques to data, from one end of its life cycle to the other.

Our task is to develop matching solutions for the problems in the engineering data environment. What does this imply? It means that each military data user must be provided with the specialized knowledge needed to perform a specific function. This frees the user from the repetitious task of laboriously searching randomized data and then correlating it for selective application.

A key factor in achieving and maintaining operational readiness of weapons systems is having the right engineering data in the right place at the right time. The preparation, organization, storage, retrieval, reproduction, and distribution of this data rely heavily on dependable machine methods. Why? Because engineering data is massive, complex, diverse, detailed, exacting, and highly technical. Decisions concerning what data is required, how it will be arranged, how it will be verified, what methods will be employed for efficient management, all involve system integration, timed to production and delivery of each weapon system.

Our aim is to tear away the barriers to engineering communication. The vital communication jobs to be accomplished are:

1. Assuring the communication of design results in such form that other technical personnel can readily understand and make use of the results;

2. Keeping management abreast where engineering data bear on decisions. To do this successfully requires speed and accuracy in problem solving, using proven machine techniques. Consequently, we will investigate the applicability of such items as closed circuit TV, microwave transmission systems, computers, electronic teleautograph, and facsimile. We must plan and develop a programmed communications approach so that the system evolved will continue to serve military needs for the future.

Needless to say, microfilm techniques, already proven and standardized within the DoD, will be an important part of the eventual over-all DoD engineering data system.

Types of Technical Drawings

by Franz Maria Feldhaus

This is a continuation of Chapter III of an authoritative and beautiful book, **THE HISTORY OF TECHNICAL DRAWING**, by Franz Maria Feldhaus published in 1959 by Franz Kuhlmann, K.G., of Wilhelmshaven, Germany, as **GESCHICHTE DES TECHNISCHEN ZEICHNENS**. We are indebted to the publisher for the translation, as well as for permission to republish this fascinating work. It will be continued in this department from month to month, until completed.—The Editors.

THE OLDEST illustrated technical manuscript dating from the Middle Ages was completed on June 23, 1405, by Konrad Keyeser in the Castle Mendicum. The author, who was born in 1366 in Eichstatt (Franken), lived in the castle as an exile, for what reason we do not know. The ruins of the castle with its high tower can still be seen at the east slope of the Erzgebirge (Burg Zebrak). Under German rule it was called Burg Bettlern.

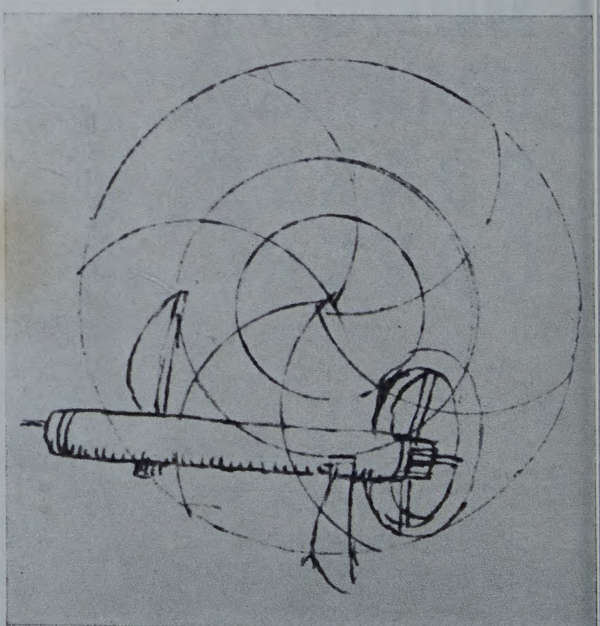
Several copies of the Keyeser manuscript have been preserved as well as one colored in by Bohemian artists and dedicated to the Emperor Rupprecht von der Pfalz. In the introduction it is also dedicated to famous dukes, military counts, glittering knights, noble army leaders, courageous captains, steadfast soldiers and other ranks. We read there: "As the heavens adorn themselves with stars, so Germany shines because of its free arts, is honored for its technical knowledge and because it excels in many industries of which we may with reason be proud." The work by Keyeser contains battle wagons as used in wars during the Middle Ages, but still being used in his time, now armored with cannons. With the antique chariots scythes were used for armor.

Among drawings of rams and assault huts sees catapults, one of which is marked with measurements that had, however, no gauge lines. The lower horizontal of that particular catapult measures 46 feet, the cross beams 23 feet. The upper lever at its longest part measures 46 feet, and 8 feet at the shortest part. Suspended from it is a box filled with stones. The longer lever arm is pulled down by a rope pulley which can be fixed. When the catches are knocked out the stone-filled box at the end of the long lever arm springs up; this catapults the sling with the stone ball, which is lying in a groove, upwards.

On going further through the drawings one finds assault bridges, gate lifters, bridges, hydraulic machines, water ducts, pumps, ascent ladders, even a boat with hand-driven paddle wheels and a lift worked by wind-driven wheel, which would lift warriors quickly onto the walls or forts.

The strangest of the drawings represents a hollow dragon with a burning paraffin lamp in its mouth to warm the air inside it; it floats as a fire signal on a mooring rope. Details of such fire dragons were found in technical drawings until the year 1540. Only in 1783 was this construction re-established by the brothers Montgolfier.

Just as the illustrated manuscript of Keyeser established a school of thought, so did a completely independent manuscript by Jacopo Mariano in Italy. The oldest of his manuscripts is kept in Florence, another one in Munich. The pen-and-ink drawings are not colored in. Mariano did not know the use of the dashed line for concealed parts. The underground axle of an animal-driven winch in the drawing breaks off and



CONSTRUCTION DRAWING OF A LIFTING CAM, 1438
State Library, Munich

is only visible again at the transmission gearing of the mill.

In the Munich manuscript by Jacopo Mariano we also find a drawing that is purely constructional. It was made for finding the most practical form of a lifting cam situated on a horizontal axle. Such cams are meant for lifting rams. As far as can be established from the sketch, they worked according to the following principle: describe the circumference of the circle made by the farthest point of the cam to reach the necessary lift. Then draw a radius and divide that piece which lies between the two circles, by three, draw a concentric auxiliary circle near the axle through the point of division. Divide the auxiliary circle by six and describe from the points of division of the radius of the auxiliary circle between the first and second circle the arc. This will give the curve of the working surface of the lifting cams. In Mariano's manuscript we also find drawings of lifting gear and mills, even of a mill with water turbines, of rams, earth drills and a machine for cutting diamonds.

In a manuscript, now kept in Vienna and dating from about 1420, the firing line was drawn for the first time; it runs straight. It was drawn in a curve, but incorrectly perceived, by the Master Gunner Martin Mercz (1471). Here we quote: "With this plan you can note the range from all guns to the target." Only Galileo Galilei recognised in 1602 the parabolic course of the firing line; but he only published his findings in 1638.

When comparing the manuscripts one finds that many objects are represented in similar ways. Thus, red metal without exception is shown in reddish color and rarely yellow, but iron is always blue.

It is strange that bolts which fitted into screws were always drawn conically. The wall painting of a screw stamp that had been excavated in Pompeii shows the same conical screws. It is not clear why this was still being done. In the same manuscript the technician shows himself also as an artist. An example is the large catapult put in front of an ornamental background. It is gothic style to cover up scenery with a wall carpet in the background.

(To be continued)

GRAPHIC SCIENCE

MAY, 1961

VOLUME 3 NUMBER 5

The Future of Engineering Graphics

Comments from several academic leaders on the role engineering graphics will play in the education of future engineers

Engineering Graphics in Transition

by Irwin Wladaver
New York University

Engineering education is in the middle of a profound self-examination. And it is right that we should never be fully satisfied with the courses and the subjects we are teaching. Every forward-looking school turns regularly to its established curriculum committee for advice about adding or deleting various courses.

When the importance of mechanical engineering was at its height, engineering drawing, engineering mechanics, machine design, and kinematics were among the essential subjects, along with elementary college mathematics. But today electrical engineering—or should I say electronic engineering—has taken over and those subjects are greatly diminished in importance and have even been discarded in some schools. The immediate future of engineering education seems to point toward mathematics and physics in their more theoretical aspects, as ends in themselves rather than as tools for practical application to engineering problems. Computer theory, programming, and readout are beginning to be thought of as essential to all engineers. Presumably the engineer will interpret the readout and turn his conclusions over to a well-trained technician, who will perform the routine job of converting a concept into a thing.

A significant example of change in educational outlook is that in the recent past a mechanical engineering student studied AC- and DC- machinery; now he's likely to study electrical circuits instead. The same is even more true of electrical engineering. Advanced calculus and vector analysis are now fairly widespread requirements; that many students can't do simple arithmetic is irrelevant.

All over the country, committees are trying to revise the curriculum, to bring it into tune with the intellectual stirrings of our day, to mold it to the contours of the unknown future. The very statement of the problem makes it obvious that a perfect job is beyond reach. All we can do is our best. "Optimize and maximize" is the current phrase, and a good one it is. And so we have groups of senior professors, the wisest we can find, searching more intensively than ever before to bring engineering education more in line with the probable challenge and the promise of the future.

We all know that the results of a search often reflect the attitudes of the searchers. Every man's opinion is naturally prejudiced in favor of his own experience. Even though we know that decisions on curriculum revision are in good hands, some of us who have been teaching engineering graphics in the colleges for many years feel that the changes and the proposed changes are entirely too drastic. Some of us, however, welcome the enforced changes with a hopeful attitude. We believe that the necessary upgrading would never originate with us because of long entrenched habits of thinking and acting, and that a hard look at engineering drawing is an opportunity to do more than change the name to engineering graphics. It may be an opportunity to introduce a new kind of vitality—not to replace the old, but to augment it.

To rehash the past, to review the wringing of hands, and to expose the internecine struggles among colleagues are all fruitless activities. Although engineering education has been for some time at a crossroads, today we can see signs pointing to the route it is most likely to take. The shape of things to come is beginning to emerge. Let us forget the wistful nostalgia for the good old days and see instead what the future of engineering graphics looks like to a group of leaders in the field, all of them professors of engineering graphics. Admittedly they are guessing. Their views may be diametrically opposed. At any rate these people do more than try to read the future. To some extent, they shape it.

Intellectual Upgrading of Graphics

by Steve M. Slaby
Princeton University

When Gaspard Monge conceived of graphical analysis through the development of descriptive geometry 170 years ago, this discovery was "classified" by the military authorities, since at the time of his discovery Monge was a military engineer in active service. His specialization was the designing and building of fortifications. Through descriptive geometry he showed to his superior officers that fortification design could be simplified and improved and time saved by this graphical approach.

Eventually descriptive geometry was de-classified and almost immediately was adopted by civil engineering educators and mathematicians as a basic scientific discipline. This discipline continued in great strength for many generations, basic to all fields of engineering and playing a most significant role in the development of many modern engineering concepts.

In recent years emphasis on pure analytical graphics, in the form of theoretical descriptive geometry concepts, has been minimized while the communication aspects of graphics in the form of engineering drawing and elementary principles of space geometry have tended to supersede theoretical graphics. This, in my opinion, has had a detrimental effect on the over-all field we now call engineering graphics.

If engineering graphics is taught only as a technique of communication then I feel that its time is limited as a college level discipline. This is evident in the recent trends in engineering curricula throughout the country where time devoted to instruction of engineering graphics has been drastically reduced. The result has been that many courses in engineering graphics have had to be further watered down in intellectual content to meet this time reduction. This in turn has set up what can be compared to a chain reaction where the critics of engineering graphics are now saying that this discipline is not a college level course, therefore it should be eliminated from the engineering curriculum. The time so gained, according to these critics, should then be used for something more vital. Of course what is more vital seems to be open to debate among the critics themselves.

The future of engineering graphics in engineering schools, in my opinion, can only be assured if the field of graphics is a growing and dynamic area of scientific and engineering knowledge. In order to be so, the field requires that it be loosened from its shackles which at the present time limit its scope to the college freshman level. Many of the details handled at the college freshman level in engineering graphics are things the student should have under his belt before he enters the university or college. Drawing technique, lettering practice, and elements of orthographic projection, taught by qualified teachers, should be the responsibility of the high schools. If this were done, then the engineering graphics educators at the college level could start their work at a higher plane and proceed at a more rapid pace. It would help them to attain a greater degree of student competence and insight in graphical communication and representation, and also to enter more profoundly into the area of graphical analysis and creative thinking.

The effort required to promote engineering graphics on the college level is one which requires the active support of all people interested in this discipline. This effort and support must not be based on propaganda alone where we try to sell engineering graphics to college administrations. It must be primarily an effort based on the upgrading of the intellectual aspects of graphics so that it will sell itself.

The modern engineering graphicists therefore must not only develop graphics as a means of communication, but also, with equal vigor, emphasize engineering graphics as a means of analysis in the concrete and the abstract, as well as a means of computation. Last but not least, engineering graphics must be taught as a background discipline for all engineers to be used as a vehicle for creative thinking.

If we in the field do this, then I feel that engineering graphics has a better chance of being considered a vital part of the engineering curricula in the eyes of our critics—and in fact!

Graphics to Get Greater Scientific Emphasis

by Richard G. Huzarski
University of New Mexico

Any attempt to predict the future trends of graphics education in engineering schools must start with an analysis of engineering graphics. As I see it after a quarter century of learning it, practicing it, and teaching it, the whole of engineering graphics is divided into two overlapping areas: graphic sciences and graphic communications.

It is the first area that must be stressed in educating an engineer. It is the second that is of prime importance to a draftsman. It is the overlapping zone of both areas where the engineer and the draftsman meet professionally.

Just how large this overlapping area is for a given team of engineers and draftsmen depends on the engineering function expected of such a team. For you and me and for other readers of this publication, it may represent a vast zone in our professional lives; for our colleagues in electronic or nuclear research, it may be only a thin sliver formed of an occasional illustration, a curve, a chart, or a nomogram.

An engineering school does not know what functions its individual freshmen and sophomores will be called upon to perform after they graduate. It must give them all an

educational basis on which their future careers will be built. A certain modicum of English, mathematics, natural and social sciences, and engineering graphics must be taught to all students.

As the engineering profession evolves so must these basic disciplines. Since the profession as a whole is becoming more scientific and less technical, engineering graphics must grow stronger in the area of graphic science: graphic mathematics, graphostatics, projective geometry, cartography, nomography, etc.

The total time allotted being limited, this growth has to be accommodated at the expense of some of the more technical areas of graphic communications. It is no longer possible to concentrate all our efforts on teaching orthographic projection, graphic standards, and drafting technology. We cannot be satisfied with training our students to be competent draftsmen. Industry does not want them trained that way. That is what the graduates of vocational and technical schools are for, we are told. Those are the people who will do the tracings, illustrating, and lettering. Our graduates must understand these functions, but need not be manually proficient in them. They must be taught the use of only those tools and techniques that will help them to design, to develop, and to convey their ideas. But beyond the use of tools and techniques they must be taught the elements of graphic sciences in ever-increasing amounts so that they will perform properly the functions reserved for engineers in a scientifically oriented culture.

It is the hard road of greater scientific emphasis and of weaker technical attainment that engineering graphics is following now and will continue to follow in our engineering schools.

Russians Show Importance of Engineering Graphics

by Matthew McNeary
University of Maine

College teachers of engineering graphics are concerned not so much by the increasing emphasis on pure science in the education of our engineers, as by the decline in instruction in applied science. No one will quarrel with the necessity for a thorough and up-to-date background in the pure sciences. The engineer is differentiated from the pure scientist, however, by his knowledge and ability in applied science, the science of design. Design is at the heart of real engineering, but we are not graduating design-oriented engineers from our colleges today. This is a serious matter.

Let us look at Russia and her spectacular successes in space technology. Many eminent American scientists are on record as having said that it is success in the design of Sputnik hardware that has placed Russia in the forefront, not her proficiency in science. Indeed, there is much reliable evidence that we are ahead in pure scientific knowledge.

An examination of Russian engineering curricula[1] shows two remarkable differences from curricula in the United States: (1) After having courses in drawing through grammar school and high school, all Russian engineers take courses in drawing, descriptive geometry, and design throughout their university career; (2) Work in industry is required either before or during higher education. The graduate engineer is expected to be a skilled draftsman and a competent craftsman in the trades pertaining to his specialty. All this is done without sacrifice in sound theoretical training.

Engineering graphics is a fundamental applied science, basic to design in the same degree as mechanics, strength of materials, fluid flow, and thermodynamics. Because of the importance of design, and because it is necessary to have our best engineering minds at work on design, I believe that engineering graphics has a secure place in our engineering college curricula. Technological survival demands it.

[1]Final Report, ASEE Engineering Exchange Mission to the Soviet Union, Journal of Engineering Education, May 1959.

Graphics—Unfashionable but Essential

by Mary F. Blade
The Cooper Union School of Engineering

When we take a hard look into the future, we find the crystal ball is quite dim when we look for graphics taught at the college level in the science-oriented engineering schools of the United States. In some of the colleges, graphics is virtually doomed for the time being, lost in the shift toward more science.

While all patterns of education, both in the high schools and in colleges and universities, are in a turmoil because of the scientific revolution now upon us, engineering education is in a double bind. Two forces are squeezing the engineering program of studies. The first of these is the demand for liberal education for engineers. In a reaction to criticism that the engineer should be educated as a whole man, a strong dose of humanistic studies has been injected into the undergraduate curriculum in the last decade so that about 20 to 25% of the students' studies are now in the socio-humanistic field. Having squeezed the engineering college programs to fit the liberal education goals, the engineering educators are presently taking a new look at the science and technology courses.

Graphics, since it is concerned with the practical arts of design and requires some skill, has become an unfashionable study, even though it has been a keystone in the fundamental courses of engineering education since the foundation of engineering colleges in this country.

Many surveys of industry have shown that there continues to be a strong demand for engineers who are able to use graphics in the invention, analysis, as well as in the description of engineering and scientific design of useful things. To meet the need for developing and training such design ability in the future, I believe that the teaching of graphics must take two new paths.

First, the teaching of engineering drawing, drafting, and descriptive geometry principles, must be strengthened in the high schools. Just as the teaching of mathematics and physics has been undergoing a change in high schools, so must the basic arts of engineering design. For too many years, we have had high school students present credit for four years of high school drawing courses, and then demonstrate a poor level of ability and learning in college graphics courses. It would appear that much more could be done in the teaching of engineering drawing and descriptive geometry in high schools.

Second, the teaching of graphics in engineering colleges should be advanced to the second or third year, and should be an integral part of the sequence of engineering design courses introduced at this time to the various branches of engineering studies. Following the practice in the European schools, descriptive geometry and graphic methods should embrace and be intertwined with the analytic methods and fundamental concepts of geometry, leading to a more eclectic approach toward problem solving.

The engineer of the future, though his image may be cast in the shadow of the theoretical scientist, will surely be required to use a pencil.

The Great Dilemma

by Jerry S. Dobrovolny
University of Illinois

In recent years, the demand to include new subject matter in engineering curricula has resulted in a reduction in time available for some of the more professionally oriented courses. Such traditional subject matter as machine design, structural detailing, surveying, and engineering drawing has been reviewed in the light of these new demands. As a result, most colleges of engineering have reduced the number of credit hours and courses devoted to engineering graphics. Here then is the first part of our great dilemma—to know the material which should be included in these courses and the amount of time necessary to cover the subject matter.

Engineering graphics, as taught to the engineering student, has to be viewed as a communication tool by the engineer. This communication will require that the engineer not only be able to read and understand difficult engineering drawings, but also be able to visualize various engineering concepts mentally so that, through the use of sketches and other forms of graphical communication, he can communicate his ideas to his colleagues and to the technician.

He must also know enough about engineering graphics to be able to supervise engineering technicians who are making the necessary drawings to translate ideas into a finished product.

The next part of our dilemma comes to mind then. Who will be making the mass of drawings which were made by engineers in the past; where will these people receive their training; and whose responsibility will it be to provide the necessary qualified teachers to supply this training? The engineering graphics and engineering drawing of two decades ago, which was taught in many of the engineering colleges, will now have to be taught in the technical institutes. The philosophy of the technical institute has not been readily accepted by the mass of the people in the United States. Therefore, a great deal of education has to take place to identify the technical institute graduate as an integral part of our engineering manpower team.

Many of the technical institutes, particularly in New York State, have adequately qualified people teaching in their respective technical specialties. However, some states which are just in the process of developing a series of technical institutes are having some difficulty in obtaining qualified staff in such areas of study as engineering graphics. The existing colleges of engineering, in co-operation with colleges of education, will have to cooperate in the development of a master's degree program for training technical institute teachers of engineering graphics. The University of Illinois is currently working on such a program.

The time has come for a thorough study of engineering graphics. The respective roles of the engineering educators, the technical institute educators, the industrial education people, and the on-the-job training programs in industry must be properly coordinated to insure an adequate supply of competently trained individuals at the various levels of responsibility in an industrial complex.

Graphics and the Engineer —Quo Vadis?

by C. P. Buck
Syracuse University

Almost anyone concerned with graphics in the past decade and a half has faced the question of the reduction of time devoted to drawing or graphics in the engineering college. Industry is concerned because it feels that the engineering graduate is coming to it inadequately prepared. The graphics teacher is concerned because he is dedicated to the idea that the engineer is professionally illiterate if he doesn't have a thorough working knowledge of engineering graphics, and because he appears to see his empire crumbling about him. What's the cause for all the concern? Is the trend of events a sensible one? What does the future hold?

Over the past fifty years, there has been a tremendous advance in knowledge in the engineering sciences. Anyone who has browsed through French's *Engineering Drawing*, first edition, published in 1911, and compared it in size and scope with present editions of engineering graphics texts needs no more graphic proof of the expansion of knowledge within a single area. Furthermore, whole new fields of endeavor have arisen: systems engineering, nuclear engineering, electronics, data processing, automation—to name but a few of the new areas and revolutionary fields of engineering endeavor.

The engineer, too, has changed as a result of the increasing complexity and amount of scientific knowledge. Gradually, he has shifted many technical responsibilities to an individual who is growing in stature on the engineering team, the engineering technician.

These changes in the characteristics of the engineer and his field have been reflected by corresponding changes in the engineering college curricula. Constant re-evaluation of the engineering curricula has resulted in elimination of some courses, addition of others, consolidation in some cases, and the addition of whole new sequences in others. The task has not been easy.

The evolution in engineering education has been much like Topsy's growth. Gradually there have been eliminated those aspects which demand a technical skill on the part of the individual, but at the same time, know-how has increased. Such courses as wood shop, pattern shop, forge shop, and foundry are out of the engineering curricula.

It was inevitable that sooner or later graphics courses would come under scrutiny. The criticism from the degree-granting departments has been that too much time has been devoted in engineering graphics courses to the teaching of pure skill. The counterargument has been two-fold: engineering graphics teachers point out that the demands of industry are for engineers who are capable of drafting and that in order to develop know-how on the part of the engineering student in the language of engineering graphics, it is necessary to teach him to be able actually to draw well. To the engineering undergraduate teacher not devoted to graphics, both these arguments seem weak. In the case of the first argument

(*Continued on page* 25)

DRAFTSMEN ARE MADE—NOT BORN

An in-plant training program set apart from the regular drafting operation enables apprentices to perform effectively on their first assignment

by H. R. Seymour and J. G. Soroka

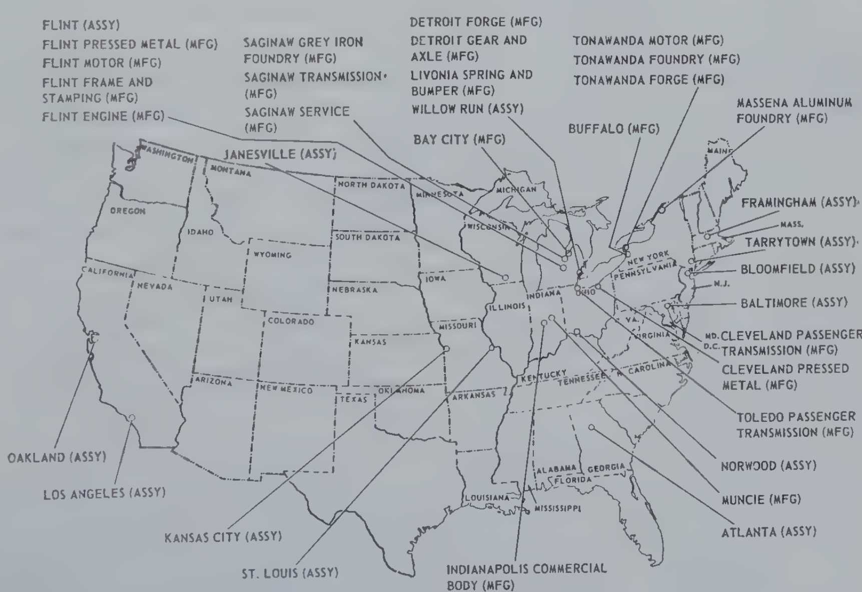
The engineering drawing of a complex automotive component represents one of the most expensive pieces of paper in the world. Millions of dollars and years of effort are devoted to the design concept shown on the drawing. On its accuracy depend production runs of millions of units. Drawings are the basis for the expenditure of millions of dollars for tooling and equipment, and thousands of contracts. How well all of these organizations function depends to a great extent on blue-print exactness. Difficulty in one plant caused by an inaccurate print can disrupt the operations of many other plants and cause serious delays. It is well known in the automotive business that much depends on how well the job of the draftsmen is done.

The important job of a draftsman involves the preparation of thousands of detail, assembly, and instruction drawings of varying complexities. Each is a complete, unabridged story, in the language of the engineer. Some are short stories, as in the case of a 9-inch by 12-inch drawing of a bolt. Others are full-length novels, as in the case of two 3½-foot by 20-foot sheet drawings that define an automobile engine cylinder and crankcase. However, all drawings have one thing in common. The stories they tell must be flawless, because the best design is only as good as the drawings that convey its mechanical message. The end product can be completed with high quality and reliability only when it is initiated with high quality design.

Who are the men who assume the important responsibility for providing the automobile industry with engineering drawings? How are they selected and how are they trained?

As a typical industrial organization whose operation revolves about product drawings, consider Chevrolet which forwards prints of drawings to 21 Chevrolet manufacturing plants and 13 assembly plants throughout the country, and in addition, sends prints to thousands of supplier firms. To develop draftsmen, Chevrolet relies upon an effective drafting training program for qualified young men. Under the direction of an experienced supervisor, trainees receive a basic education in automotive drafting. The training group is set apart from the regular drafting operation. In this way men are trained to assume regular drafting-room assignments after a specified period, but the training is not accomplished at the expense of quality drawings and products.

The method of training draftsmen has changed with all other techniques in the automotive industry. Years ago drawings were prepared first in pencil and then traced in ink. The assignment as a tracer provided good experience for trainees. This method has been eliminated by improvements in the tools of the trade which make possible the use of the initial pencil drawing. Tracing experience has



CHEVROLET forwards prints of drawings to 21 manufacturing plants and 13 assembly plants throughout the country, and, in addition, sends prints to thousands of supplier firms.

been replaced by improved training methods.

Chevrolet's training program, inaugurated in 1937, has been in continuous operation with the exception of the period between 1942 and 1946. The program is conducted at the Chevrolet Engineering Center in Warren, Michigan, for young men interested in automotive drafting. Its primary objective is to supplement previous education in drafting fundamentals with practical job-related training. Chevrolet has found that regardless of the amount of fundamental drafting a man has had, he will need also specific training in company automotive drafting techniques. This enables the apprentice to perform effectively on his first assignment as a detailer, and to develop further through additional experience and education.

To be eligible for this program, the applicant must: be less than 26 years of age; be a high school graduate with at least six semesters of mechanical drawing, two semesters of algebra, and two semesters of plane geometry or the equivalent; be in good health; have a pleasing personality; and have the potential to progress to professional status.

SCREENING APPLICANTS

Preliminary screening of applicants is accomplished by the following aptitude tests:

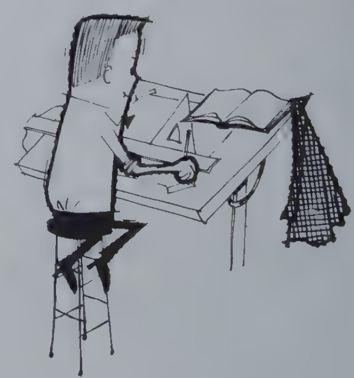
1. Mechanical Comprehension Test (Bennett AA) – to measure capacity to understand various types of physical and mechanical relationships.
2. Wonderlic Personnel Test (A)–to measure mental ability and mental alertness.
3. Minnesota Paper Form Board Test–to measure ability to read and interpret blue prints.
4. Thurstone Temperament Schedule–to appraise character traits as active, vigorous, impulsive, dominant, stable, sociable, or reflective; and to establish an over-all temperament percentile rating.

PERSONAL INTERVIEW

Final selection of applicants is made after a personal interview during which a primary objective is to confirm the applicant's interest and desires in the drafting profession.

In operation, the training program consists of 34 problems or drawings starting with fundamental plates of lettering, lines, and tangents, and continuing with stampings, castings, forgings, cutting sections, and assemblies. The problems are separated into six groups.

1. *Fundamentals.* The assignments in this group further develop drawing techniques such as lettering, line work, and tangents through practice.
2. *Projection.* These drawings have a plan view and side view requiring an end view by projection. Another requirement is to tilt one of the views and complete the other two views by projection.
3. *Castings.* An isometric picture with all main dimensions is given and the trainee must make a working drawing showing all necessary views, sections, placement of dimensions in their proper locations, and all necessary notes pertaining to casting drawings.
4. *Stampings.* These drawings have a plan view, side view, and an end view with dimensions omitted. The trainee is required to show all necessary additional views and sections, to clarify depressions, to dimension fully the part, and to add all notes. Also in this category, a drawing problem is assigned with three views given, and several sections are required to be cut to show the different contours of the part.
5. *Detailing from layouts.* A print of the layout is given to the trainee and he is required to make a working drawing of one of the parts shown on the layout. The layout has all necessary views and critical dimensions given. The trainee is required to complete a detail drawing of the part by placing the views in their correct positions, completely dimensioning (obtaining dimensions by scaling the layout when necessary), and by adding all notes to complete the drawing.
6. *Assembly drawings.* The trainee is given a print of an existing assembly drawing showing a cutaway section of only a portion of the assembly. All sub-assembly numbers and loose part numbers are called out on the print. The trainee is required to show a cutaway section of the complete assembly, working from the details and drawing all the parts to scale. Preparation of an assembly drawing is a very important phase of the training program.



TRAINING PROGRAM

In addition to the 34 drawings completed in the categories above, 21 descriptive geometry problems are assigned. These are integrated with regular drawing assignments. All work is submitted to the supervisor for grading of accuracy, neatness, and procedure. All significant inaccuracies must be corrected or redrawn.

The average trainee requires approximately 500 hours to complete all assignments. There are two check points during the program at which a trainee must have satisfactorily completed a minimum number of assignments to qualify for continuation in the program. Recognition of satisfactory completion is fulfilled with the presentation of a wallet-size certificate which denotes the recipient as a qualified detail draftsman.

Upon his completion of the formal program the trainee is assigned work on actual product-design drawings. However, the trainee continues to work under the jurisdiction of the training supervisor for a period of approximately four months. This is to ascertain that he is thoroughly familiar with fundamentals and is applying them properly in his drafting techniques. After assurance that training is complete and effective, he is formally transferred to the detailing department under the jurisdiction of regular detailing supervisors. This procedure relieves detailing supervision from the task of training inexprienced draftsmen in fundamental procedures and policies.

JOB ASSIGNMENT

Although the young men who complete this program are qualified junior draftsmen, their proficiency is still considered limited, and their drafting is restricted to relatively minor assignments. Nevertheless, their potential to handle major assignments has been proven. Training is merely the first step in making a draftsman. Nevertheless, it is absolutely essential to a firm foundation on which to further develop abilities through on-the-job experience and additional formal technical education.

About 30 percent of the men presently in Chevrolet engineering management began their careers in the drafting rooms. Many of these men owe their rapid rise to the excellent groundwork they received in automotive fundamentals in drafting training programs. Thus at Chevrolet, at least, these programs have proven to be highly beneficial to both the individual and the company.

The Authors

J. G. SOROKA—Eighteen years experience in product engineering drafting activities. Employee of Chevrolet Motor Division since 1954 with design, checking and supervisory responsibilities. Supervisor of drafting training since May, 1960.

H. R. SEYMOUR—Employee of Chevrolet Motor Division since 1941 with design, checking and supervisory responsibilities. Chief draftsman-administration since 1955. Attended Flint Junior College and Illinois Institute of Technology.

Better Illustrations for Technical Journals

An analysis of unprofessional illustrations in professional journals and what do do about them

by J. Getsko

DESPITE straightforward and clearly written instructions, many technical journals exhibit inconsistently executed drawings and graphs. Insufficient or improper distinctions in line weight between grids and curves, incorrect lettering height, and other distractions often impart an unprofessional appearance to a publication that typographically is of top quality.

Why does this irregularity occur? My experience is that the professional society depends on the author, the author depends on the drafting department, and the drafting department head is not interested since he is normally a designer rather than a graphic arts specialist.

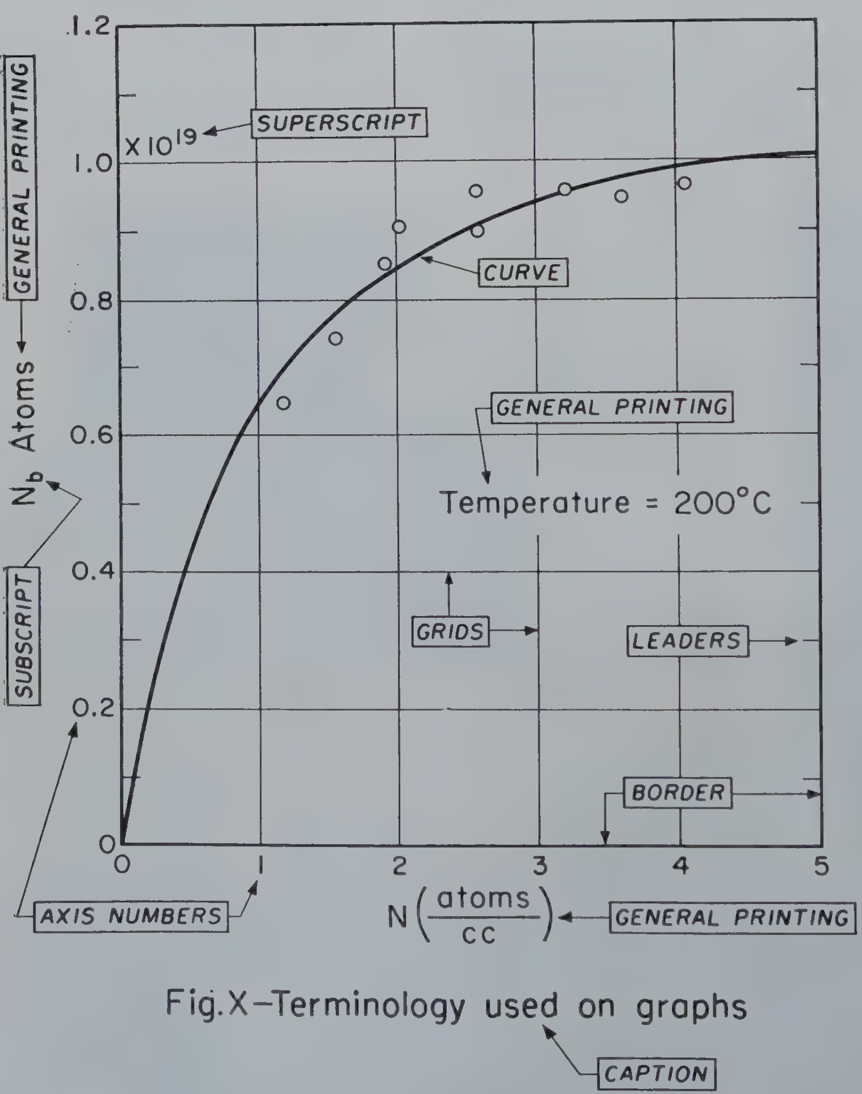


FIGURE 1. Basic Standard for graphs.

Consequently, he hires a girl or boy just out of high school and classifies him as a tracer or junior draftsman. This individual is told that if he continues his schooling, his future as a design draftsman is assured. Therefore, tracing or illustration work becomes a stepping stone to other fields. If the tracer is a boy, he is advanced before he has complete knowledge of the tracing art. If it is a girl, normally she gets married. What can be done to help this situation?

One approach to the problem is to isolate the work of producing graphs and drawings from the normal drafting effort. Employees can be hired who have art rather than drafting ambitions. After they have been trained in the use of the Leroy lettering instrument and in the drafting practices employed in making good quality art for reproduction, they can begin to share in the productive load of the drafting unit.

As a training aid, the tracer should be given some simple rules as well as a standard or guide to follow. This eliminates both time-consuming calculations and slipshod guesswork from the preparation. Charts supply the information he needs in a form that can be easily understood and readily followed.

Charts to Simplify

HERE IS THE way such a chart may be put together. Knowing that the publisher wants the minimum lettering height to be 0.060″ after reduction, we proceed to establish a standard basic size after reduction

DRAWING SIZE		LINE WIDTH			PEN NO.	GENERAL PRINTING						AXIS NUMBERS		PEN NO.	CAPTION					
						CAP. & L.C.	GREEK		SUBS & SUPER						CAP & L.C.	GREEK		SUB & SUPER		
									CAP. L.C.	GREEK								CAP. L.C.	GREEK	
WIDE	MAX. HEIGHT	HEAVY	MED.	THIN			CAP.	*L.C.		CAP.	*L.C.	CAP.	SUB & SUPER			CAP.	*L.C.		CAP.	*L.C.
3	9	.015	.010	.005	000	100	100	120	060	060	080	080	060	00	120	120	140	080	080	100
4	12	.020	.013	.007	000	120	120	140	080	080	100	100	080	00	140	140	175	100	100	120
5	15	.025	.017	.008	00	140	140	175	100	100	120	120	100	0	175	175	200	120	120	140
6	18	.030	.020	.010	0	175	175	200	120	120	140	140	120	1	200	200	240	140	140	175
7	21	.035	.023	.012	0	200	200	240	140	140	175	175	140	1	240	240	290	175	175	200
8	24	.040	.027	.013	1	240	240	290	175	175	200	200	175	2	290	290	350	175	175	200
9	27	.045	.030	.015	1	240	240	290	175	175	200	200	175	2	290	290	350	200	200	240
10	30	.050	.033	.017	2	290	290	350	200	200	240	240	200	3	350	350	425	240	240	290
11	33	.055	.037	.018	2	290	290	350	200	200	240	240	200	3	350	350	425	240	240	290
12	36	.060	.040	.020	3	350	350	425	240	240	290	290	240	4	425	425	500	290	290	350
13	39	.065	.043	.022	3	350	350	425	240	240	290	290	240	4	425	425	500	290	290	350
14	42	.070	.047	.023	3	425	425	500	290	290	350	350	290	4	500	500	700	350	350	425
15	45	.075	.050	.025	4	425	425	500	290	290	350	350	290	5	500	500	700	350	350	425
16	48	.080	.053	.027	4	425	425	500	290	290	350	350	290	5	500	500	700	350	350	425
17	51	.085	.057	.028	4	500	500	700	350	350	425	425	350	5	700	700	1000	425	425	500
18	54	.090	.060	.030	4	500	500	700	350	350	425	425	350	5	700	700	1000	425	425	500
19	57	.095	.063	.032	4	500	500	700	350	350	425	425	350	5	700	700	1000	425	425	500
20	60	.100	.067	.033	5	500	500	700	350	350	425	425	350	6	700	700	1000	425	425	500
21	63	.105	.070	.035	5	500	500	700	425	425	500	500	425	6	700	700	1000	500	500	700
22	66	.110	.073	.037	5	500	500	700	425	425	500	500	425	6	700	700	1000	500	500	700
23	69	.115	.077	.038	5	500	500	700	425	425	500	500	425	6	700	700	1000	500	500	700
24	72	.120	.080	.040	6	700	700	1000	425	425	500	500	425	7	1000	1000	1000	500	500	700
25	75	.125	.083	.042	6	700	700	1000	425	425	500	500	425	7	1000	1000	1000	500	500	700
26	78	.130	.087	.043	6	700	700	1000	425	425	500	500	425	7	1000	1000	1000	500	500	700
27	81	.135	.090	.045	6	700	700	1000	500	500	700	700	500	7	1000	1000	1000	700	700	1000

* THIS DOES NOT APPLY TO $\beta, \delta, \zeta, \theta, \lambda, \xi, \chi, \psi$ – USE SAME SIZE AS CAPS

FIGURE 2. Line widths and lettering sizes for illustrations appearing in scientific journals (printed column width—3 inches).

(Fig. 1). We choose an 0.070″ height for general printing and axis numbers, 0.060″ for subscripts and superscripts, and 0.088″ for captions. Three line thicknesses are chosen: light (0.005″) for grids, pointer lines, dimension lines, cross-hatching, etc.; medium (0.010″) for drawings and borders on graphs; and heavy (0.015″) for emphasis, such as for the curves of a graph and for directional arrows. Points are made three times the curve line thickness.

Since a column 3″ wide by 9″ deep is most frequently employed by the technical journals, we use this as the basis for our chart (Fig. 2).

We can then calculate the changes in our basic line widths and lettering heights for larger areas, proportional, of course, to the basic 3- by 9-inch area assumed for the final size of the journal column. The lettering sizes obviously have to be chosen to fit the available Leroy guides. Any number of widths can be chosen, however, since they are easily controlled by adjustment of the ruling pen.

To obtain the accuracy needed in adjusting his pen to the prescribed line width, the tracer uses an inexpensive shop microscope (Fig. 3). A suitable instrument is made by the Bausch & Lomb Optical Company (Catalog No. 31-29-33), which has 40X magnification, a scale divided into 0.001″ built into the lens, and a built-in light.

Returning to our standardization chart (Fig. 2), a word is in order on the basic considerations used in arriving at the sizes shown. Since both capital and lower-case lettering is used, the height of the lower-case character is used as the standardization base. To maintain this basic height, the Leroy guide size is increased for many of the Greek characters in both the normal and the superscript and subscript positions. The axis numbers are also given a different size because of the lower-case size standard.

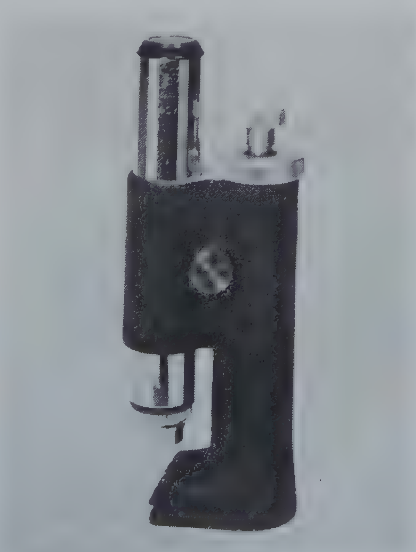


FIGURE 3. Shop microscope can be used to adjust pen for exact line width.

Although most technical journals typeset the illustration captions, the addition of such a legend serves to ensure proper identification of the figure. In addition, it allows the artwork to be used readily for internal reports and slides.

At first glance the standardization chart appears formidable. In practice, however, the draftsman finds such a tool actually simplifies his job. It eliminates the calculating and guesswork, and—best of all—it gives his finished art the professional uniformity that distinguishes both himself and the publication it ultimately appears in.

The Author

JOSEPH GETSKO is head of the drafting department of the Westinghouse Research Laboratories in Pittsburgh, Pa. He attended Carnegie Institute of Technology and Westinghouse Technical School and is a member of the American Society of Mechanical Engineers.

HIGH SCHOOL REPRODUCTION TRAINING

Drafting students at Chicago Vocational High School learn to use diazo equipment to copy their drawings

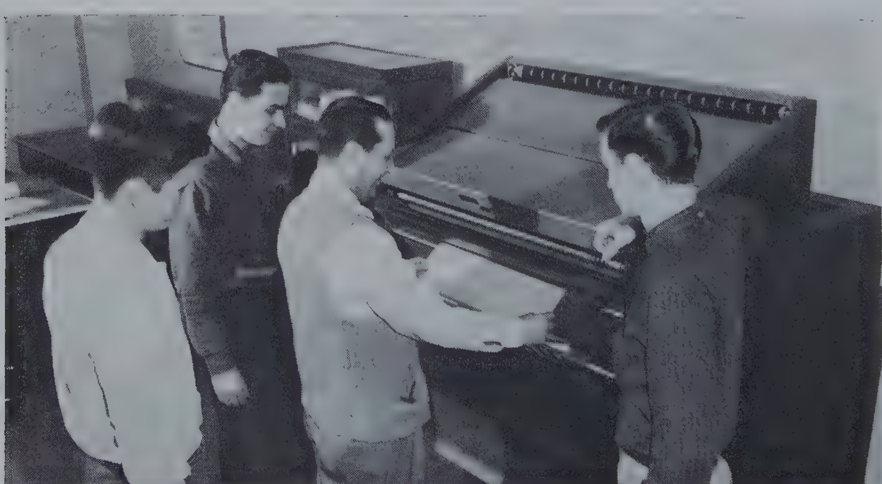
KEY TO THE SUCCESS of Chicago Vocational High School is an up - to - date vocational instruction program which, added to the basic academic curriculum, gives students the knowledge and skill they need in order to take their places as productive employees in industry. Located on the threshold of one of the world's great steel-making areas in South Chicago, the school occupies one of the largest secondary school buildings in the United States. In addition to 4,250 students enrolled in grades 9 to 12, there is a weekly attendance of over 200 apprentices.

Every department is provided with equipment that will actually be used by the student when he goes into the business world. For example, machine drafting majors are instructed in every phase of the job they will be expected to do after graduation. Not only do they learn basic drafting techniques, but they also become familiar with modern reproduction machines used to make copies of engineering drawings.

James Crowe, the director of Chicago Vocational High School, is a former draftsman and drafting teacher, who takes a personal interest in the drafting classes. He sees that faculty members are kept posted on recent developments in the copying-machine field through the use of all the latest booklets, catalogs, and sales literature.

Three years ago, Chicago Vocational High School acquired a diazo-type reproduction machine for engineering drawings to replace its outdated blue-print machines. According to Mr. Roy Young, teacher of machine drafting and design, students copy their own drawings on a Copyflex diazo reproduction machine. "The boys use the machine to make intermediates, tracings and whiteprints," Mr. Young said. "We have two—a Model 20 and a Model 300. "Learning how to use reproducible copies, or intermediates, is particularly valuable to the students. They learn how most of the reproducible drafting work on a basic item can be confined to one drawing. Copies of the basic drawing are made on the machine, and modifications are added with a minimum of drafting work."

In keeping with the school's program of simulating realistic work situations, machine drafting students make drawings of items that actually will be made in the school's shop. After the drawing is made, a copy of it is run off in the diazo machine.



Copying is rapid and simple. The original drawing, made on a translucent sheet, is placed over a sensitized sheet of copy paper. Both sheets are fed into the diazo machine, then travel around a glass cylinder that houses a light source. The light passes through the original, and causes a chemical change in the coating on the sensitized paper.

The original is then returned while the sensitized sheet passes through rolls that apply developer. This developer converts the coating on the sensitized paper to a clear, black-on-white copy of the original.

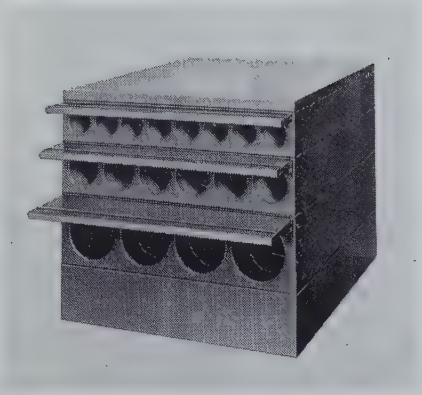
Copies run off on the machine are sent to the school shop. The original is kept on file in the drafting office, which gives the student a chance to get double criticism on his work. The teacher can make suggestions about the original from the point of view of the principles he is trying to impart. The shop foreman evaluates the drawing for accuracy of dimensions, and sends drawings back for revision where necessary.

Every student in the machine drafting curriculum spends the final ten weeks of each school year working on a special project. Five weeks are spent planning the project, and five weeks are devoted to making drawings.

The current year's project is a winch for a cargo ship. Students are given necessary vital information, such as the horsepower of the motor, the tonnage to be lifted, etc., and told to go to work.

"We are quite pleased with the way this reproduction training has worked out. Using a copying machine is a psychological help in teaching the boys. They can make copies of their work and take it home to their parents," said Mr. Young recently. "It gives them something to be proud of."

New Products



Controlled Filing System

A new modern modular approach to filing rolled tracings, prints, and other rolled material has been announced by the Hamilton Manufacturing Co., Dept. 385, Two Rivers, Wisc. The Moducor System consists of four, six, and eight tube modules in three different diameters. All modules are of a standard width to permit stacking any size modules for varying storage requirements. Tubes are paper laminate, foil wrapped with steel ends, and are anchored mechanically in a sturdy steel frame. All modules are reversible, and unit heights vary according to tube diameter.

Parchment for Whiteprinters

Patapar 44-45, a medium weight translucent parchment master for use on office whiteprint copying machines, has been added to its line of parchments by Paterson Parchment Paper Co., Bristol, Pa. It is designed for offices desiring a direct copy master for special applications, may be used on such whiteprint copying machines as Ozalid, Bruning, Peck & Harvey, Revolute, and Pease. More economical than treated or impregnated papers, it offers unusual brightness and visual opacity, and will transmit ultraviolet light at a very high rate assuring high printing speeds.

(For additional information regarding the new products described here, write the manufacturer directly. Complete addresses are included.)

Speed-Master Camera

A horizontal bed camera, constructed entirely of metal and operating with a high degree of accuracy, is being introduced by Graphic Industries, Inc., Lacey-Luci Products Div., 52-58 Arlington St., Newark, N. J., The semi-portable unit occupies a space 20″ wide and 50″ long on a table or bench. Adjustable lights, controlled by an automatic reset timer, are attached to the 20- by 20-inch tilting copyboard. An enlargement or reduction ratio of more than two times is possible. The camera produces high quality work when used for line or halftone work for Veloxes, photo copies, etc.

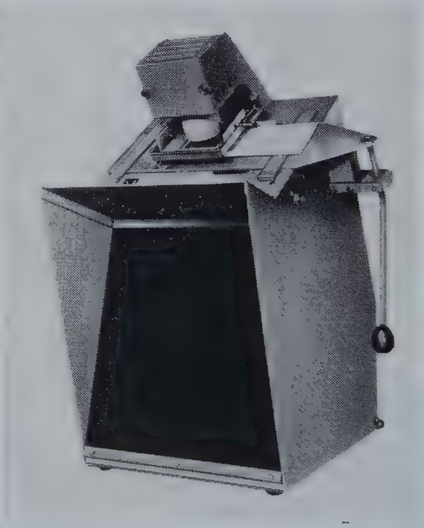
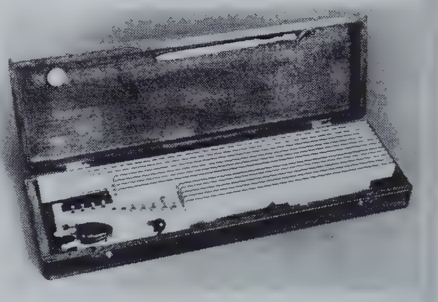


Table Model Card Reader

A table model 35 mm. microfilm card reader designed especially for brilliantly lighted drafting rooms has just been introduced by Eugene Dietzgen Co., 2425 North Sheffield Ave., Chicago 14, Ill. Filmcard Reader model 4305 projects a sharp bright image of uniform intensity on a 10½- by 10-inch glare-free screen of newly developed plastic crystals. The unit has a magnifying power of fourteen times. A single control makes it possible to move the film image in all directions and a scanning device makes possible rapid viewing of selected film image areas.



Lettering Set

A new lettering set at an economical price is now being offered on the market by Unitech Corp., 50 Colfax Ave., Clifton, N. J., under the trade name Unitech. Made of three layers of flexible material to prevent warping and distortion, the templates have a scaling guide for centering. There are twelve templates in all, with Gothic letters and numerals, in sizes ranging from .06 inches to 1.00 inch in height. Each letter is engraved complete to eliminate shifting. The pen works by capillary action to control even flow of ink and uniform lines. There are five assortments of sets.

Blue Drafting Film

A new drafting film with a blue tint has recently been announced by B. K. Elliott Co., 536 Penn Ave., Pittsburgh, Pa. Called Stascale, the Du Pont Mylar polyester base drafting film eliminates the need for using special pencils. In addition, it takes India ink, lies flat on the board, erases easily without leaving "ghosts," and re-inks without feathering. In microfilming programs where blue-tint drafting media have been used successfully, Stascale also will give excellent results. Available in white, too.

Combination Slide Rule

The Jeff-Ette, a combination slide rule and pencil, has recently been put on the market by Alvin & Co., Inc., Palisado Ave., Windsor, Conn. The slide rule has A, B, C, and D scales on the face, and sides of the rule incorporate a 4-inch drawing scale divided into 32nds and a millimeter rule up to 10 centimeters.

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he may point out that industry is seeking to get draftsmen with an engineer's training. However, is this the most economical use of the engineering graduate? Is it not better to train them especially for this in a technical institute, develop their skill in drafting and give them some of the rudiments of engineering so that they will be better able to comprehend the work which they are doing? In fact, this is precisely what is happening in many instances today. In answer to the second argument, curriculum builders have simply told graphics teachers, "We can no longer give you six or nine credit hours. You will have to reduce this to four or three, or less. It will be up to you to determine what you are going to keep and what you are going to leave out. We simply want our engineers to have a rudimentary knowledge of the graphic language and to be able to execute a simple engineering drawing, preferably free hand, but in any event, with a minimum of emphasis on skill. We are not interested in developing skilled technicians."

Does the engineer in industry today have a need for less graphics? No! Actually, he has a need for a greater knowledge of graphics and its uses in engineering. It is true that industry frequently puts the young engineer on the board to familiarize him with the company's products and many of its processes. How then can we justify the elimination of the teaching of graphics technique in the undergraduate engineering curriculum? Is it going to be the responsiblity of industry to develop this skill? Not necessarily. First of all we are going to have to do in graphics what we have done in mathematics and other basic courses. We do not start an engineer in college in the basic elements of mathematics. Who would want to take the time to teach an engineering student how to add, multiply, and divide? We expect him to come to college with a background in many of the skills and techniques of mathematics often through advanced algebra. Similarly, we can expect a prospective engineering student to do the same as far as graphics skills are concerned. He should come with an ability to turn out a good, neat drawing. He should come to us with a fundamental knowledge of orthographic projection. This does not mean trying to teach engineering drawing in high school. Most teachers recognize that it is foolish to use problem examples that require considerable depth of knowledge beyond the student's current understanding of a topic. One half-year of drawing in high school as a minimum, preferably taken in the last half of his senior year, would probably be sufficient to teach the student to turn out a good sketch or line drawing and to become familiar with the fundamentals of orthographic projection. If we are to maintain the student's technical ability throughout his college experience, we must require that in all of his engineering college work, he be expected, when he makes a graphical presentation, to make that presentation properly. If we do this, the graduating engineering student will be able to go on the board if he is requested to do so, simply because he has had a continuing experience on the board all during his engineering education. Furthermore, from the standpoint of graphical know-how, we will have an individual who has considerably greater depth in this know-how as to the uses and applications of graphics to

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his field than many engineering graduates today.

Assuming a capability on the part of the individual in the basic skills of graphics (the ability to make a good line drawing and to letter well), we can then devote our time to teaching him how to use graphics as a method of analysis, representation, and presentation in his engineering work. Here again, our engineering graphics program of the past—and present, in many cases—has been open to criticism. It has been heavily slanted toward perfection on the part of the student in turning out a good working drawing. A considerable portion of engineering graphics teachers today have been reluctant to include such topics as graphical mathematics in their engineering graphics courses. There is so much concern about the student's ability to turn out a good sketch or drawing that little, if any, attention is given to acquainting the student with the many opportunities for applications of graphics to all fields of engineering other than the machine working drawing. Descriptive geometry is taught, but even here emphasis is frequently on its use in the solution of strictly abstract problems and not its broader aspects of application to various engineering problem areas. Nor are engineering students taught what methods are available today in the rapid handling, processing, and storage of graphical information so vital to the smooth functioning of an engineering organization. How many courses include information on the use of engineering graphics in the presentation of technical data? The engineer has constant need for the ability to do this well, in reports, proposals, lectures, etc., and to varied audiences. He should have knowledge of this, too, to assist him in his undergraduate work.

The course in engineering graphics in the freshman year at college to accomplish these objectives could be a single three-credit-hour course having three class periods of one hour each. Class procedure would be on the lecture-recitation basis. Emphasis would be on know-how. Such drafting as is required for problem solutions or presentation development would be done on a homework basis, and freehand solutions would be emphasized and encouraged wherever feasible. Such classroom equipment as gridded blackboards and overhead and opaque projectors would be available for student presentation. A blackboard drafting machine would be available as needed for lecture demonstrations. Student equipment for home use could consist of a small combination board and triangles with built-in edge guides which would be approximately 17″ x 22″ in size. Drafting tools could consist of a pocket kit containing a large master bow compass, a pair of dividers, and a good chuck pencil.

It may well be that in the future our graphics courses will cease to exist in the form that we have them today. This will not mean that a knowledge of graphics will not continue to be required by the engineer; for graphics is a very important tool of the engineer.

There is no question that the engineer will still have to think and plan. In the process of developing his ideas he will continue to use devices for getting his thoughts into pictures that can be read and understood. These devices may be exotic in nature in the future, but for some time to come one set of devices he is going to continue to use to develop his thoughts graphically will probably be pencil and paper.

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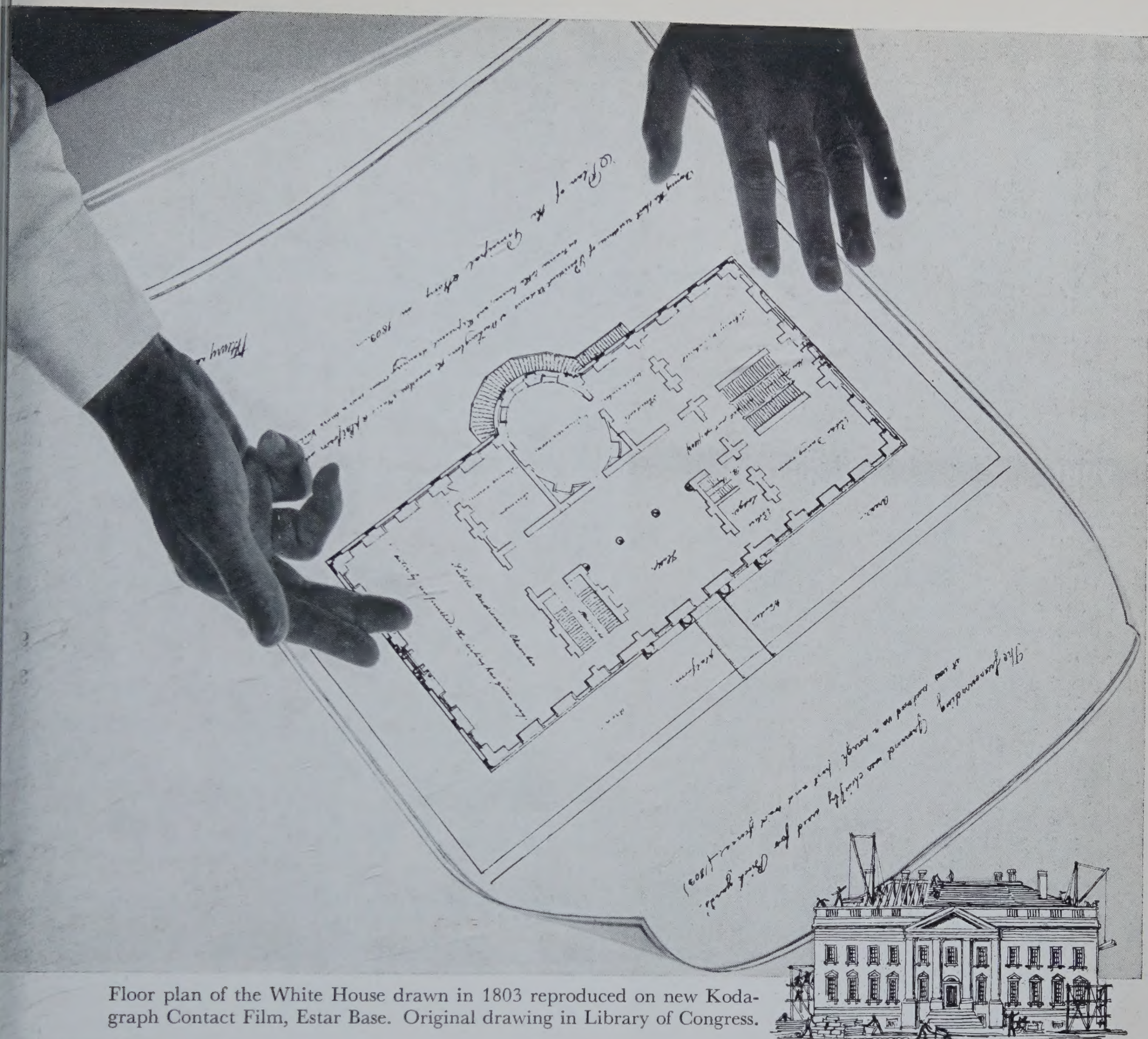

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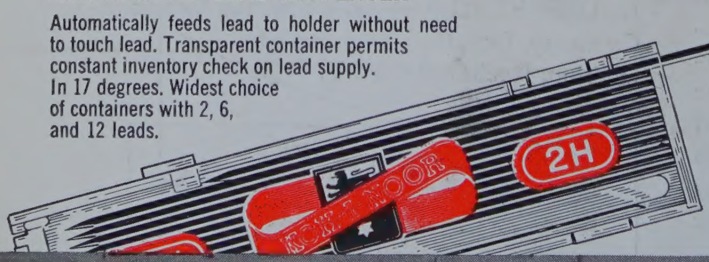

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